NERAL ELECTRIC

APPARATUS SERVICE BUSINESS DIVISION

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SUBJECT
-

COPIES:
HJ Gottlieb
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Evansville I&CES Shop Mgr.

FLOYD

To: All Telco Shops

The enclosed TTS-77 manual includes a "must do" modification.

This modification can be done by the I&CES shops and all necessary instructions are at the rear of the manual. If this modification is not performed, the unit will cause the craftsman to misalign the stepping relays utilized by the telephone companies. Affected units are those above serial #54 with date stamp prior to April 1979.

If questions arise, clal 8*235-9912.

Tom

T.W. Oakes, Specialist - Market Development
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INSTRUMENTATION AND COMMUNICATION EQUIPMENT SERVICE PROGRAMS

/rg
Enclosure

NORTHEAST ELECTRONICS
A DIVISION OF NORTHERN TELECOM, INC.
INSTRUCTION MANUAL

MODEL TTS 77
RELAY CURRENT TEST SET

No. A0077-00-600 ISSUE 3 DATE OCT 1976

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IN U.S.A.

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SECTION 1

DESCRIPTION

.1 INTRODUCTION.

.2 The Northeast Electronics Model TTS 77 Relay Current Flow Test Set is a portable, solid-state unit designed to test and adjust electromechanical relays. The unit acts as an adjustable current source that is placed n series with the relay under test. Four independent current levels can be set, locked, and then selected by front panel or remote switches. Output current is accurately monitored on a 250-degree meter with a knife edge needle and mirror. The unit can be used to monitor or set current levels that correspond to the operate, non-operate, release and hold performance specifications of a relay. The TTS 77 is provided with a remote control cable and a 7-foot test cable, both stored in the cover. No power cord is supplied with the test set.

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SECTION 2

SPECIFICATIONS

2.1 INTRODUCTION.

2.2 Table 2—1 lists the specifications for the TTS 77.

Table 2—1. Specifications.

ELECTRICAL	
Meter Ranges:	1.5, 15, 75 and 750 milliamperes full scale.
Accuracy:	±2% full scale all ranges.
Tracking:	±1.5% full scale all ranges.
Regulation:	7 volts ≤ Vr ≤ 56 volts, ±4% full scale all ranges. 10 volts ≤ Vr ≤ 56 volts, ±2% full scale all ranges.
Power Dissipation:	30 watts maximum at 0°C (+32°F), 20 watts maximum at 25°C (+77°F), 10 watts maximum at 50°C (−122°F), Self protecting.
Power Input (48V):	−42 volts to −56 volts at 780 milliamperes maximum.
MECHANICAL	
Overall Dimensions:	9 in. h x 7 in. w x 6 in. d (22.9 cm x 17.8 cm x 15.3 cm) with cover.
Weight:	6 lb. (2.72 kg.).
Remote Control:	Five momentary switches for remote control of test relays for the four current and NORMAL-REVERSE.
Test Leads:	A 7-foot cable with a 310-type connector on one end and two chucking tools on the other end.
ENVIRONMENTAL	
Ambient Temperature:	0°C (−32°F) to +50°C (+122°F).
Relative Humidity:	30% to 90%.

SECTION 3

OPERATING INSTRUCTIONS

3.1 INTRODUCTION.

3.2 Table 3–1 lists the function of the controls, indicators and connectors shown on Figure 3–1, with their reference designators. Paragraphs 3.3 through 3.9 provide the necessary information for the operation of the TTS 77.

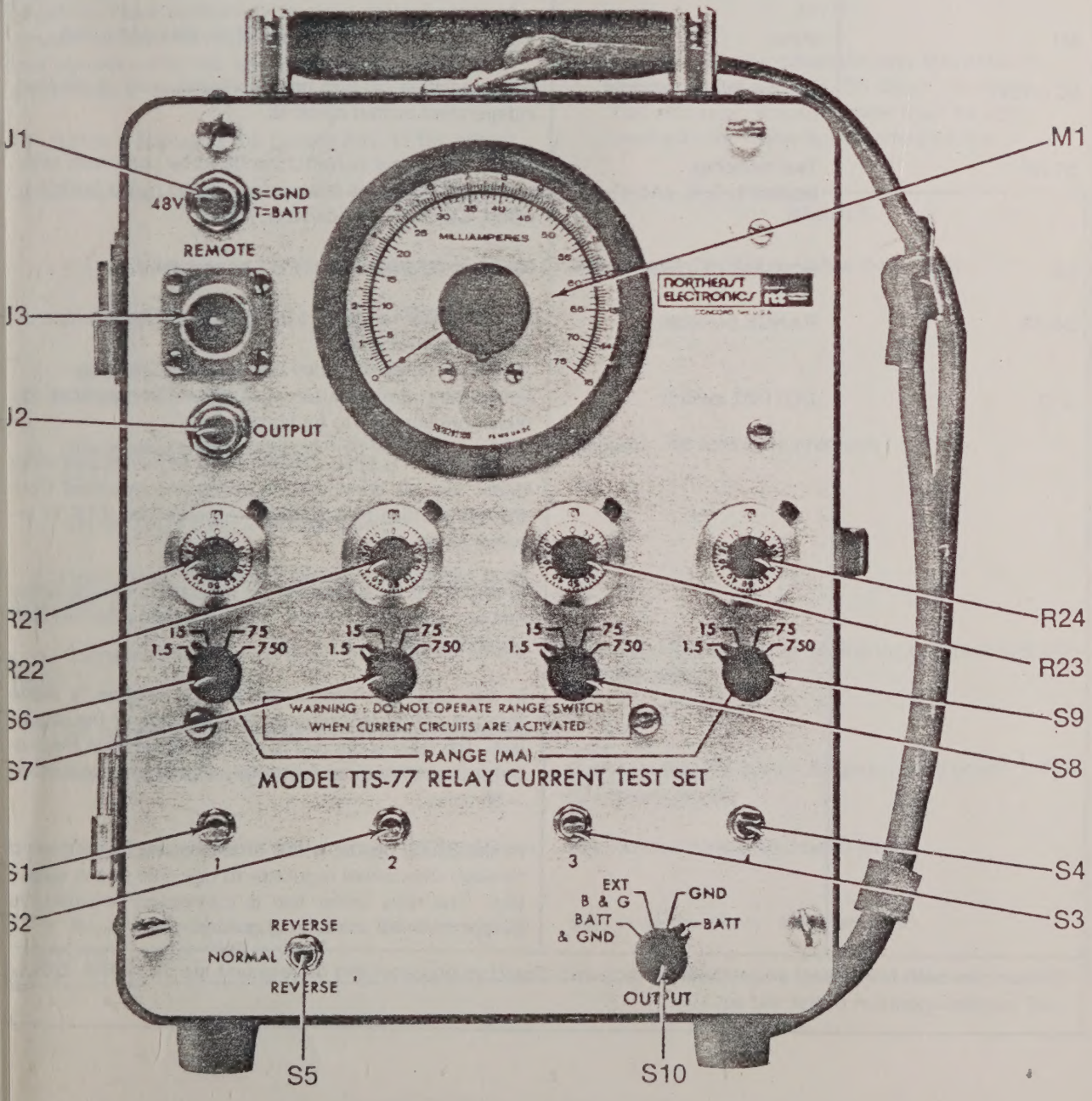


Figure 3–1. Controls, Indicators and Connectors.

Table 3—1. Front Panel Controls, Indicators and Connectors.

REF DESIG	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
J1	48V jack	Type 310 connector for 48 volt power source.
J2	OUTPUT jack	Type 310 connector for output of regulated current to relay under test.
J3	REMOTE ADAPTER	Adapter for remote control pushbuttons used to control test switch relays and NORMAL-REVERSE relay.
M1	Meter	Indicates current being supplied to relay under test.
R21-R24	Current adjust controls	High-resolution, 10-turn potentiometers used to set four independent output currents.
S1-S4	Test switches labeled 1, 2, 3, and 4*	Select the output current circuits to be used with relay under test. Down is momentary action, up is latch position. Center is off position.
S5	NORMAL-REVERSE switch*	Reverses polarity of OUTPUT connector J2.
S6-S9	RANGE switches	Selects meter range of 1.5, 15, 75 or 750 milliamperes for each current circuit.
S10	OUTPUT switch	Establishes correct battery and ground connections for relay configuration to be tested. In the BATT & GND position, the regulator and relay under test are connected in series and operated from the same office battery used to power the TTS 77 internal relays. In the EXT B & G position, the regulator and relay under test are operated in series with an external battery and ground supply. In the GND position, a ground connection is made through the current regulator to one side of the output jack. The relay under test is connected between the output jack and an external battery supply (not to exceed −56 volts). In the BATT position, the office battery is connected through the current regulator to one side of the output jack. The relay under test is connected between the output jack and an external ground.

*Present on both front panel and remote control unit. Switches on panel and remote unit are in parallel. Either will control operation of the test set.

3.3 RELAY PERFORMANCE REQUIREMENTS.

3.4 Operate. When the operate value of current flow (specified in the relay adjustment sheet) is applied through the relay under test, the armature should move sufficiently to close all normally-open contacts and open all normally-closed contacts. If the relay does not operate within the test values in the operate column, adjust the relay.

3.5 Non-operate. When the non-operate value of current flow (specified in the relay adjustment sheet) is applied through the relay winding under test, the armature should not move sufficiently to close normally-opened contacts nor open normally-closed contacts. If the relay does operate within the test values in the non-operate column, adjust the relay.

3.6 Release. Reducing the current flow to the release value (specified in the relay adjustment sheet) should allow the relay to return to its non-operate position.

3.7 Hold. With the relay operated, reducing the current flow to the hold value (specified on the relay adjustment sheet) should allow the relay to remain in the operated position.

3.8 PRESETTING OUTPUT CURRENTS.

3.9 To preset the four output currents, perform the following procedure.

NOTE

The TTS 77 was calibrated with the meter in the horizontal position. To obtain the specified accuracy, the instrument must be operated with the meter in the same position.

ACTION	RESULT
a. Set test switches S1-S4 to center position.	Disconnects RANGE switches from meter.
b. Set NORMAL-REVERSE switch to NORMAL.	
c. Insert 310-type plug and cable (customer supplied) into 48V jack, J1.	
d. Attach other end of cable to −48 volts. S = GND, T = BATT	Applies −48 volts to instrument.
e. Set OUTPUT switch to GND position.	
f. Insert 7-foot Northeast Electronics-supplied relay test cable to OUTPUT jack J2.	
g. Connect white lead of relay test cable to a load relay.	Provides current path for setting up current adjust controls R21-R24.
h. Set corresponding RANGE switch to desired range.	
i. Set number 1 test switch to up position.	Connects RANGE switch S6 and current adjust control R21 to regulator.
j. Adjust current control R21 to obtain desired current level.	Sets output current to desired level.
k. Repeat steps g through j to set the three remaining current circuits, R22 to R24.	Sets output currents to desired levels.

3.10 OPERATING INSTRUCTIONS.

3.11 The operating procedures described in the following paragraphs are not intended to limit the operator in using the full capabilities of the TTS 77 test set. Familiarity with the operating features described previously will permit variations in procedures to accommodate known test requirements. The remote control unit can be used for any test instead of the front panel toggle switches by connecting the remote control cable to the test set's REMOTE ADAPTER jack.

3.12 Refer to the relay adjustment specifications, supplied with relays, and paragraph 3.8 to preset the specified curent levels for the operate, hold, release and non-operate conditions of the relay under test.

3.13 TESTING SINGLE-WOUND RELAYS.

3.14 To test single-wound relays perform the following steps.

NOTE

Before proceeding with any test, determine the electrical configuration of the relay with respect to battery and ground. Refer to Figure 3—2.

ACTION	RESULT
a. Preset currents to relay performance requirements, refer to paragraph 3.8.	
b. Insulate the contacts that control the relay.	Isolates coil access terminals of relay.
c. Set OUTPUT switch to GND or BATT position as required.	
d. Connect black chucking tool to relay coil access terminal for ground relay test, or white chucking tool for battery relay tests. Refer to Figure 3—2.	Supplies —48 volts for a grounded relay or ground for a battery relay, through current regulator to relay under test.
e. Set appropriate test switch that will be used to supply non-operate current to up position.	Applies non-operate current to relay under test. Relay should not operate.
f. Return test switch to center position.	Removes non-operate current from relay.
g. Set appropriate test switch that will be used to supply operate current to up position.	Applies operate current to relay under test. Relay should operate.
h. Set appropriate test switch that will be used to supply hold current to up position and then return operate current test switch to center position.	Applies hold current to relay under test and then removes operate current. Relay should remain operated.
i. Set appropriate test switch that will be used to supply release current to up position and then return hold current test switch to center position.	Applies release current to relay under test and then removes hold current. Relay should release.
j. Return release current test switch to center position.	Removes release current from relay under test.

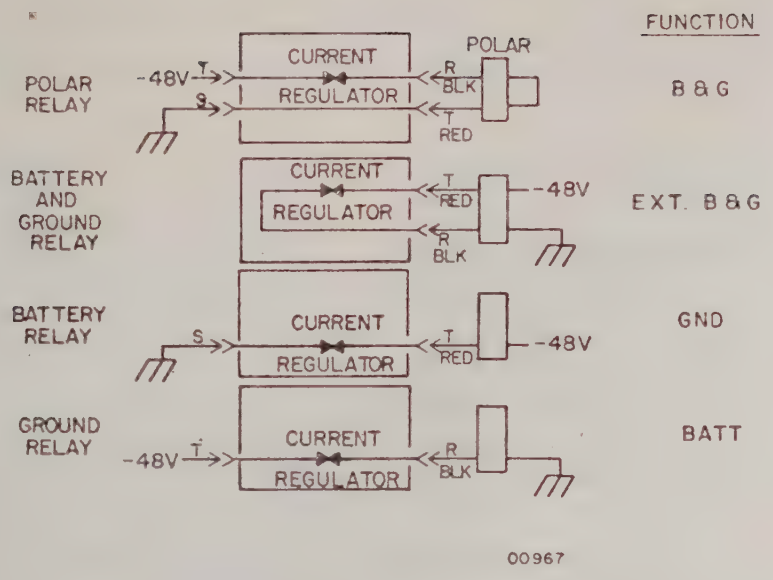


Figure 3—2. Relay Test Configurations.

3.15 TESTING DOUBLE-WOUND RELAYS.

3.16 To test double-wound relays perform the following steps.

ACTION	RESULT
a. Preset currents to relay performance requirements, refer to paragraph 3.8.	
b. Insulate contacts that control relay under test.	Isolates coil access terminals of relay.
c. Set OUTPUT switch to EXT B & G position.	
d. Connect black chucking tool to grounded coil and white chucking tool to battery supplied coil.	Uses external office battery and ground to test double-wound coil.
e. Set appropriate test switch that will be used to supply non-operate current to up position.	Applies non-operate current to relay under test. Relay should not operate.
f. Return non-operate test switch to center position.	Removes non-operate current from relay.
g. Set appropriate test switch that will be used to supply hold current to up position and then return operate test switch to center position.	Applies hold current to relay under test and then removes operate current. Relay should remain operated.
i. Set appropriate test switch that will be used to supply release current to up position and then return hold test switch to center position.	Applies release current to relay under test and then removes hold current. Relay should release.
j. Return release current test switch to center position.	Removes release current from relay.

3.17 By placing the OUTPUT switch in the BATT position, only the grounded coil is in the circuit and the battery coil is in effect shorted out. The battery-supplied coil is tested singularly when the switch is in the GND position.

3.18 **TESTING POLAR RELAYS.**

3.19 To test polar relays perform the following steps.

ACTION	RESULT
a. Preset currents to relay performance requirements refer to paragraph 3.8.	
b. Insulate contacts that control relay under test.	Isolates coil access terminals of relay.
c. Set OUTPUT switch to BATT & GND position.	
d. Connect white and black chucking tools to terminals of polar relay.	Supplies −48 volts and ground to polar relay coil.
e. Set appropriate test switch that will be used to supply non-operate current to up position.	Applies non-operate current to relay under test. Relay should not operate.
f. Set NORMAL-REVERSE switch to REVERSE position.	Reverses OUTPUT current. Relay should not operate in reverse direction.
g. Return non-operate test switch to center position.	Removes non-operate current from relay.
h. Set appropriate test switch that will be used to supply operate current to up position.	Applies operate current to relay under test. Relay should operate.
i. Set NORMAL-REVERSE switch to NORMAL position.	Reverses OUTPUT current. Relay should switch and operate.
j. Return operate current test switch to center position.	Removes operate current from relay.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION.

4.2 Paragraphs 4.3 through 4.14 with schematic diagram, Figure 7–1, provide circuit descriptions for the Model TTS 77.

4.3 REFERENCE CURRENT.

4.4 A reference current of 200 microamperes is maintained with FET Q3. This current provides a reference voltage at the base of Q1, one side of a differential amplifier, through test switches S1, S2, S3 or S4 depending on the current circuit used. A strap is provided, to be replaced by an ammeter, to monitor the reference current during calibration. Potentiometer R12 is used to adjust the current. The reference current flows through selected current adjust potentiometer, either R21, R22, R23 or R24. The voltage at the wiper is used as a reference voltage.

4.5 AMPLIFIERS.

4.6 A differential amplifier, comprised of transistors Q1 and Q2, operates with three stages of current gain provided by transistors Q4, Q5 and Q6 to maintain the voltage across the emitter resistors of Q6 equal to the reference voltage at the base of Q1. The output current is therefore dependent upon the reference voltage and the emitter resistor selected. The emitter resistors are selected by front panel RANGE switches S6 through S9. One RANGE switch is associated with each test switch. In the 1.5 milliampere range the Q6 emitter resistors are R1 and R2 in series with resistor R9. In the 15 milliampere range they are R3 and R4. In the 75 milliampere range they are R5 and R6, and in the 750 milliampere range the emitter resistors are R7 and R8.

4.7 CURRENT CONTROL.

4.8 The current circuit to be monitored by meter M1 is selected with test switches S1 through S4, which operate corresponding relays K1 through K4. RANGE switches S6 through S9, are rotary switches that select the current range to be used. Resistors R21 through R24 are 10 turn potentiometers used to adjust the OUTPUT currents within the limits of their corresponding RANGE switches. When none of the RANGE switches (S6-S9) are operated (via front panel test switches S1-S4 or via relays K2-K4) or if an operated RANGE switch is set at 1.5 mA, relay K6 remains unoperated. This leaves transistor Q6 collector open and prevents the leakage of Q6 from flowing into an external circuit. Diodes CR7 and CR11 protect the test set against current reversal.

4.9 METER CIRCUIT.

4.10 The voltage developed across the selected emitter resistor is measured by meter M1 through series resistor R9 and shunt resistors R10 and R11. Two diodes, CR9 and CR10, provide over voltage protection for the meter. The meter is calibrated in milliamperes and indicates the OUTPUT current.

4.11 NORMAL-REVERSE AND REMOTE CONTROL.

4.12 Current circuits 1 through 4 can also be selected by the remote adapter. The NORMAL-REVERSE relay can also be controlled by the remote control switch. The NORMAL-REVERSE relay is controlled by front panel switch S10. Relay K5 reverses the leads to the OUTPUT jack J2.

4.13 THERMAL PROTECTION.

4.14 Power transistors Q5 and Q6 are automatically protected from damage due to overheating by thermal switch S11 mounted on the same heatsink. The switch operates and removes power from the regulator when the heatsink temperature exceeds +80°C (+176°F). When the heatsink cools to approximately +70°C (+158°F), the switch releases and power to the regulator is restored.

SECTION 5

MAINTENANCE AND CALIBRATION

.1 INTRODUCTION.

.2 The Model TTS 77 does not require routine preentive maintenance. This section, therefore, provides nly the information and instructions necessary to calirate the test set.

.3 SERVICE INFORMATION.

.4 Each instrument manufactured by Northeast Elecronics is warrented for a period of one year upon delivery to the original purchaser. Written authorization is equired prior to the return of any equipment for factory epairs. Additional service information can be obtained y contacting Northeast Electronics, Customer Service epartment, P. O. Box 649, Concord, New Hampshire, 3301, telephone number 603-224-6511.

.5 TEST EQUIPMENT REQUIRED.

.6 The following test equipment is required for calration of the TTS 77.

1. DC ammeter with an accuracy of 0.1% or better nd capable of measuring currents of 200 ua and 750 nA.

2. 35-ohm resistor capable of dissipating 30 watts.

3. Test cable with a 310 type plug on end and two lligator clips on the other end.

.7 CALIBRATION.

.8 To calibrate the Model TTS 77, perform the follow-ng steps.

1. Set meter mechanical zero with the test set in the horizontal position.

2. Unlock all RANGE controls. (Refer to Figure 3—1 or locations of controls and switches.)

3. Set test switches S1 through S4 to neutral position (middle position).

4 Set RANGE switch S6 at 750, S7 at 1.5, S8 at 1.5, and S9 at 1.5.

.5 Set REVERSE/NORMAL/REVERSE (MON) switch S5 at NORMAL.

6. Set OUTPUT switch S10 at BATT & GND.

7. Remove the four front panel screws and the two screws on the back of the case. Lift assembly from case. Use case to support assembly in a horizontal position leaving free access to the top of the assembly.

NOTE

All adjustments are made with the assembly in a horizontal position.

8. Remove strap connected to "+" and "—" terminals located in upper right-hand corner of printed circuit (pc) board.

9. Connect external ammeter to the "+" and "—" pc board terminals. Ensure that correct polarity is maintained.

10. Prepare ammeter to measure 200 uA.

11. Connect 35-ohm, 30-watt resistor to OUTPUT jack J2 with a 310 test cord. The resistor heats up during testing and should be placed on a nonflammable work surface.

12. Apply power to 48V jack J1 (T = BATT, S = GND).

13. Set test set switch S1 in the up position.

14. Adjust RANGE control R21 for approximate full scale on panel meter M1. Observe that the 35-ohm resistor warms up indicating external current flow.

15. Adjust pc board potentiometer R12 to obtain 200 ± 5 uA on the external ammeter. (Refer to Figure 6—1 for pc board parts locations.)

16. Set test switch S1 in the neutral position and remove power from 48V jack J1.

17. Disconnect external ammeter and reconnect strap to the "+" and "—" pc board terminals.

18. Connect ammeter in series with the 35-ohm resistor to OUTPUT jack J2 (the white lead of the test cord toward the positive side of the meter and the black lead toward the negative side of the meter).

19. Prepare ammeter to measure 750 mA.

20 Apply power to 48V jack J1 (T = BATT, S = GND)

21. Set test switch S1 in the up position.

22. Adjust RANGE control R21 to obtain 750 ± 5 mA on the external ammeter.

NOTE

On panel meter adjustments, gently tap the meter face to overcome movement friction and obtain a true scale indication.

23. Adjust pc board potentiometer R11 to obtain a **precise** full scale reading of 750 mA on panel meter M1.

24. Set RANGE switch S6 at 75.

25. Prepare ammeter to measure 75 mA.

26. Adjust RANGE control R21 to obtain a **precise** full scale reading of 75 mA on panel meter M1.

27. Adjust pc board potentiometer R6 to obtain 75 ± 0.5 mA on the external ammeter.

28. Set RANGE switch S6 at 15.

29. Prepare ammeter to measure 15 mA.

30. Adjust RANGE control R21 to obtain a **precise** full scale reading of 15 mA on panel meter M1.

31. Adjust pc board potentiometer R4 to obtain 15 ± 0.1 mA on the external ammeter.

32. Set RANGE switch S6 at 1.5.

33. Prepare ammeter to measure 1.5 mA.

34. Adjust RANGE control R21 to obtain 1.50 ± 0.01 mA on the external ammeter.

35. Adjust pc board R2 to obtain a **precise** full scale reading of 1.5 mA on panel meter M1.

36. Set test switch S1 in neutral position.

37. Remove power from 48V jack J1.

38. Disconnect ammeter and 35-ohm resistor from output jack J2.

39. Apply glyptol (or equivalent) to the adjustment screws of potentiometers R2, R4, R6, R11 and R12.

40. Replace assembly in carrying case and secure assembly with four front panel screws and two screws on the back of the case.

41. This completes the calibration.

SECTION 6

ELECTRONIC PARTS LISTS

6.1 INTRODUCTION.

6.2 This section provides the parts lists and associated component location drawings for easy location and identification of parts. Tables 6—1 through 6—3 are the parts lists and Figure 6—1 is the component location diagram for the TTS 77.

Table 6—1. TTS 77 Overall Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
A1	ASSY PC 96012						A007700013
J1-2	JACK,TEL,SWCRFT SCHEM 4				SWCRFT	L12B	650100300
J3	12PIN RECEPT SQ.FLANGE				AMPHENOL	165-12	651200300
M1	METER,TTS77 DEFL 280				BEEDE	913476	901200201
Q5	CASE M4	40W		80V	TI	TIP32B	552000322
Q6	TO-3 85.7W			-80V	TI	2N4903	552049030
R21-24	10 K	2 W	5%		SPECTROL	534	233101031
S1-5	DPDT	5A		28V	C+K COMP	7207P3YZB	620400800
S6-9	SW,ROT,2D,1POL,4POS,N/S				GRAYHILL	9A30-2-1-4N	626500600
S10	30 DEG	4A			GRAYHILL	9A30-02-2-4N	626500700
S11	190F OUT 160 F IN				ELMWOOD	3001-16-90	805001401
TB1-2	TIEPOINT,TRIPLE HORIZ.				CINCH	53E	836400400
TB3	TIEPOINT,SINGLE				CINCH	51	836400100

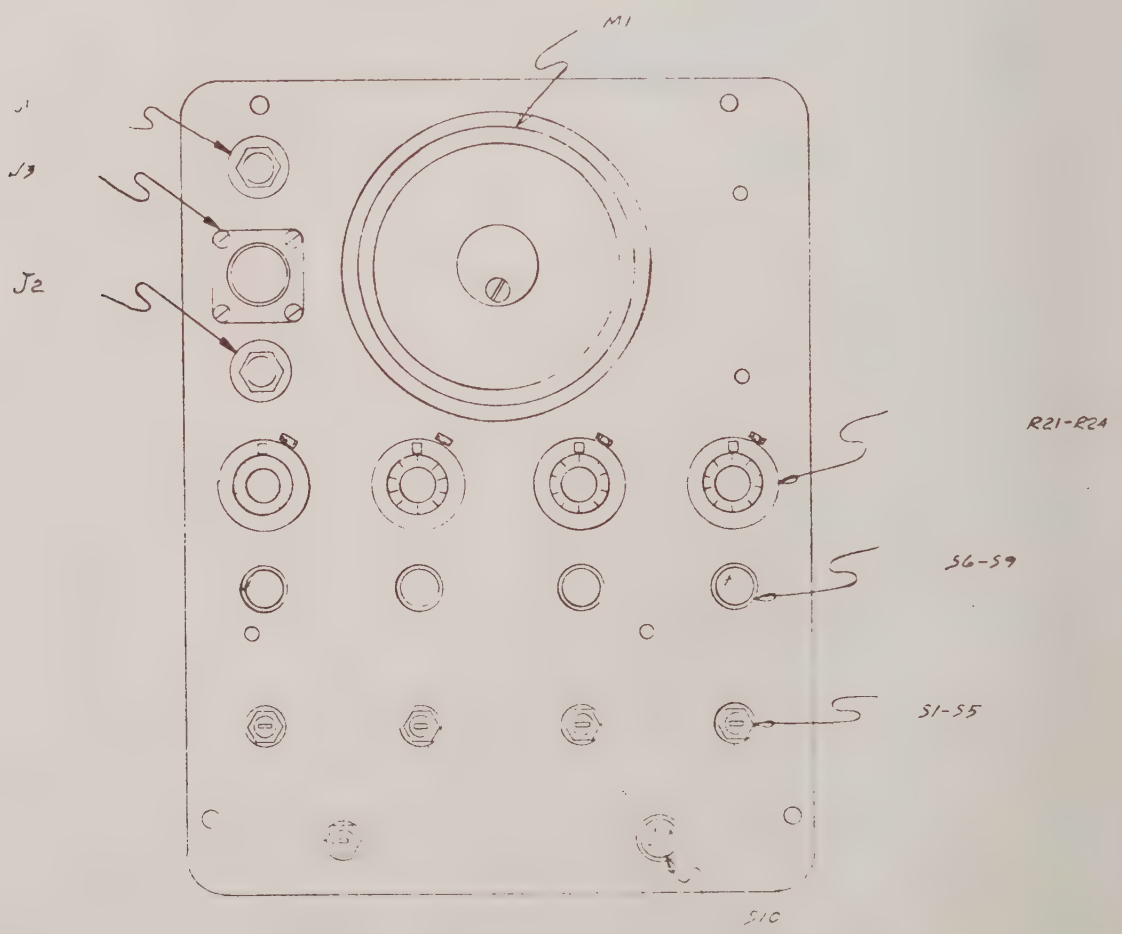
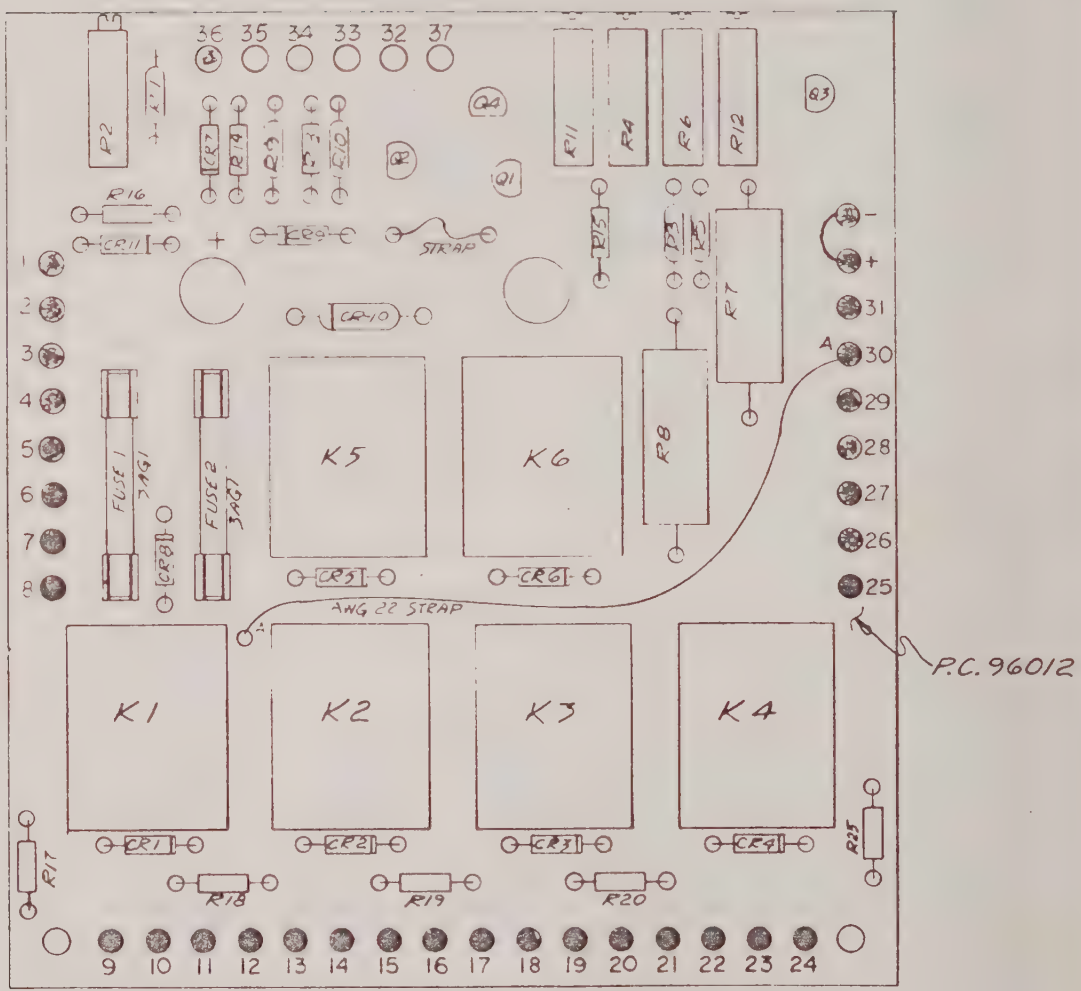


Figure 6—1. Front Panel Assembly Parts Locations.

Table 6–2. TTS 77 Assembly A1.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
CR1-8	D041			600V	EDAL	IN4005	560040050
CR9	1ZT MA 20				DICKSON	IN751A	562007511
CR10	CASE 17	5W	5%	62V	MOTOROLA	IN5372B	562053722
CR11	D041			600V	EDAL	IN4005	560040050
F1-2	FUSE 3AG				LITTELFUSE	3AG	863100400
K1-6	RELAY,4C-PC				MIDTEX	156-24D-1A2	604100800
Q1-2	TRANSISTOR PUP				MOTOROLA	MPS A-56	552000560
Q3	CASE 29	1-5MA		60V	MOTOROLA	2N5463	555005463
Q4	AUDIO DRIVER/OUTPUT				MOTOROLA	MPS-A06	550000060
R1	1000-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220210011
R2	1K	.75W	10%		HELIPOT	89PR1K	232501020
R3	78.7-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220278791
R4	50-	.75W	10%		HELIPOT	89PR50	232505000
R5	30.9-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220230991
R6	100-	.75W	10%		HELIPOT	89PR100	232501010
R7	2-	2W	5%		IRC	BWH	210202095
R8	20W	3W	5%		W LEONARD	TYPE 3X	210302005
R9	768-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220276801
R10	806-	1/8W	1%		ELECTRA	RN55 SIZE 100 PPM	220280601
R11	2K	.75W	10%		HELIPOT	89PR2K	232502020
R12	10K	.75W	10%		HELIPOT	89PR10K	232501030
R13	100K	1/4W	10%		AB	TYPE CB	200101046
R14-16	10K	1/4W	10%		AB	TYPE CB	200101036
R17-20	47K	1/4W	10%		AB	TYPE CB	200104736
R25	10K	1/4W	10%		AB	TYPE CB	200101036
XF1-4	3AG				LITTELFUSE	102069	863300300



1 SHADED AREAS ARE LARGE QUICK DISCONNECT.

Figure 6—2. TTS 77 Assembly A1, Component Location Diagram.

Table 6—3. Remote Switch Assembly Parts List.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
P1	12PIN PLUG				AMPHENOL	165-9	651200400
S1	1A-CON	1/8A		10VA	C. RESEARC	T00425-02-2-2-2-2-2	635900600

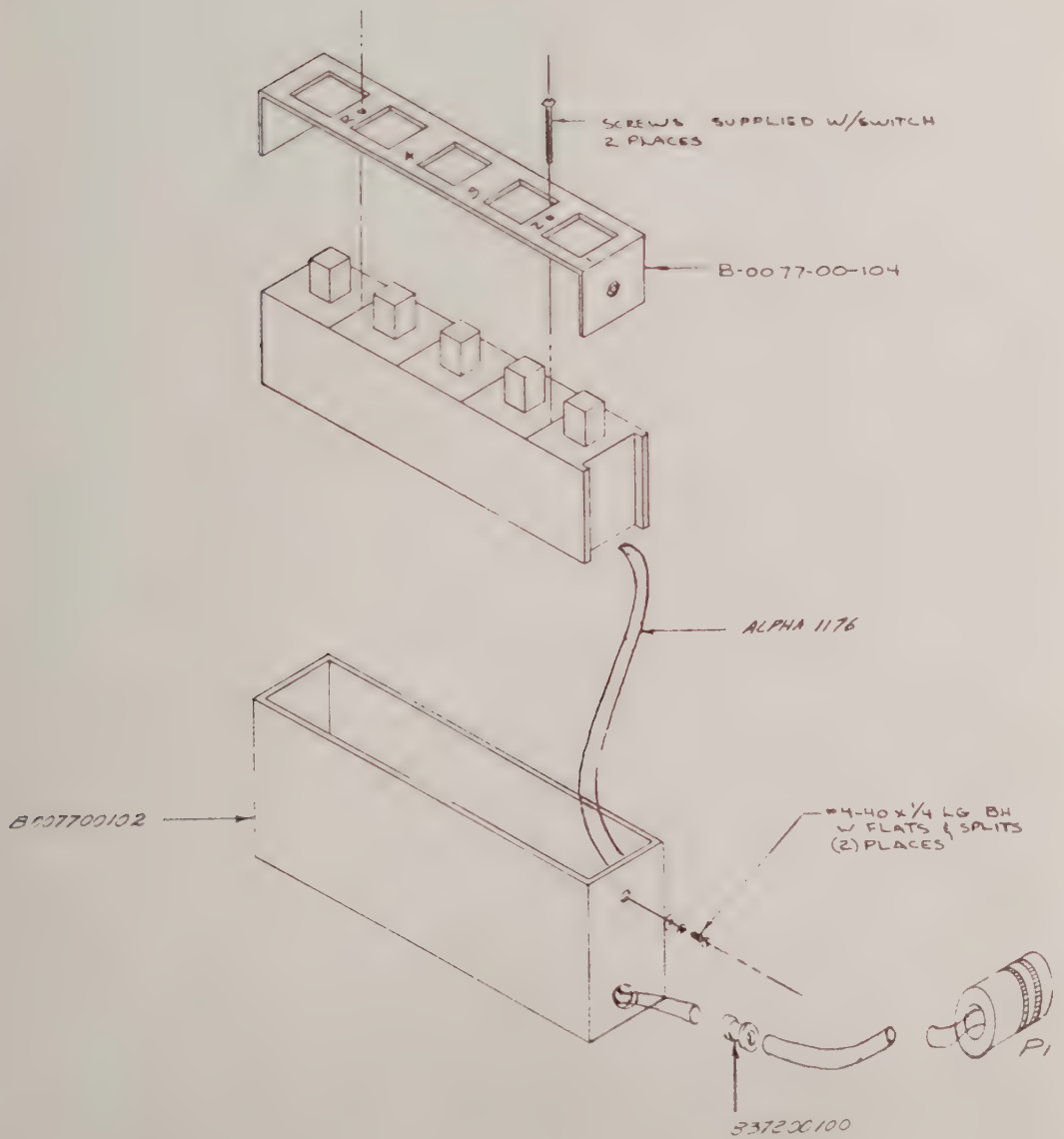


Figure 6—3. Remote Control Switch Assembly.

SECTION 8

MODEL DIFFERENCES

8.1 Earlier units of the TTS 77 Relay Current Test Set had a different front panel but were electrically identical with the present units. Figure 8—1 shows the earlier front panel and Table 8—1 gives the overall part list for the earlier units. Earlier units use printed circuit board pc C0077-00-013. The test cable supplied with earlier units was a 4-foot long cable with a 310-type connector on one end and two alligator clips on the other end.

Table 8—1. Overall Parts List of Earlier Units.

REFERENCE DESIGNATOR	DESCRIPTION VALUE	POWER	TOL	VOLTS	MFGR.	MFGR. PART NO.	N.E. PART NO.
..	ASSY PC 26312				NORTH-EAST ELECTRONICS		C007700013
J1-2	JACK,TEL,SWCRFT SCHEM 4				SWCRFT	L12B	650100300
J3	12PIN RECEPT SQ.FLANGE				AMPHENOL	165-12	651200300
M1	METER,TTS77 DEFL 280				BEEDE	913476	901200201
Q5	CASE M4	40W		80V	TI	TIP32B	552000322
Q6	TO-3 85.7W			-80V	TI	2N4903	552049030
R21-24	10 K	2 W	5%		SPECTROL	534B	233101031
S1-5	DPDT	5A		28V	C+K COMP	7207P	620400800
S6-9	30 DEG	4A			GRAYHILL	9A30-02-2-4N	626500700
S10	SW,ROT,2D,1POL,4POS,N/S				GRAYHILL	9A30-2-1-4N	626500600
S11	190F OUT 160 F IN				ELMWOOD	3001-16-90	805001401

SECTION 7

SCHEMATIC DIAGRAMS

7.1 INTRODUCTION.

7.2 [illegible]

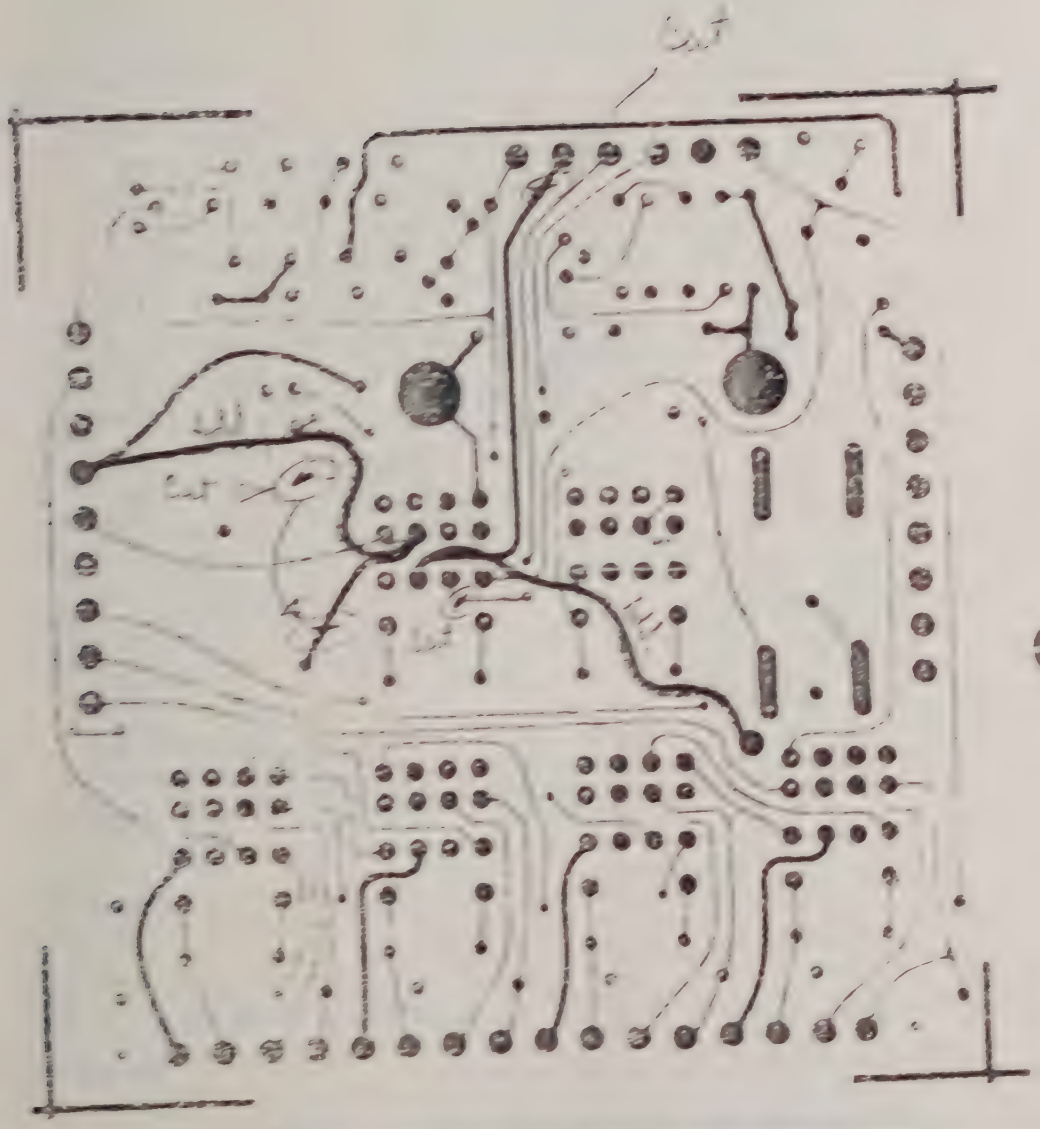
NOTE

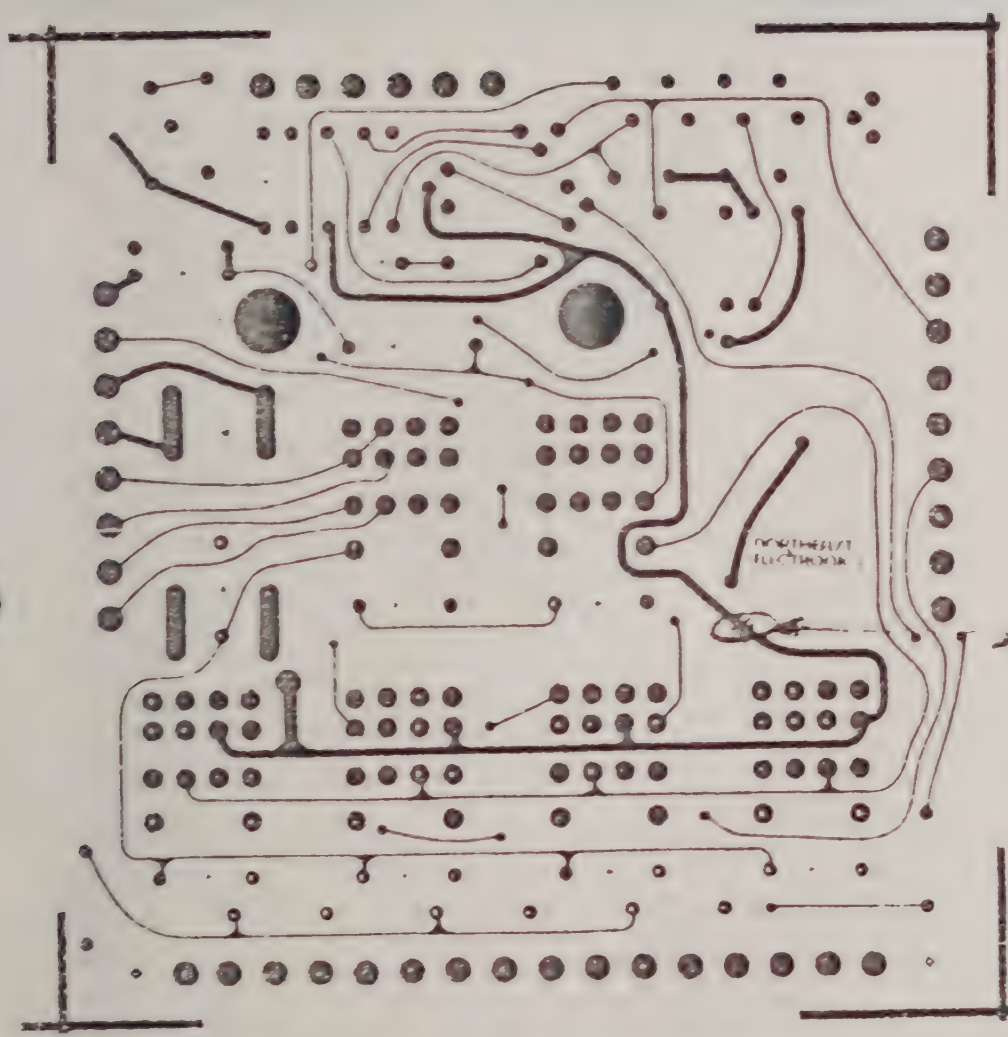
[illegible] bave 9.1 Kohms resis- [illegible] for R17, R18, R19 [illegible] potentiometer in [illegible]

Ref. ECO-77

1-31-79

R.J. Lemere

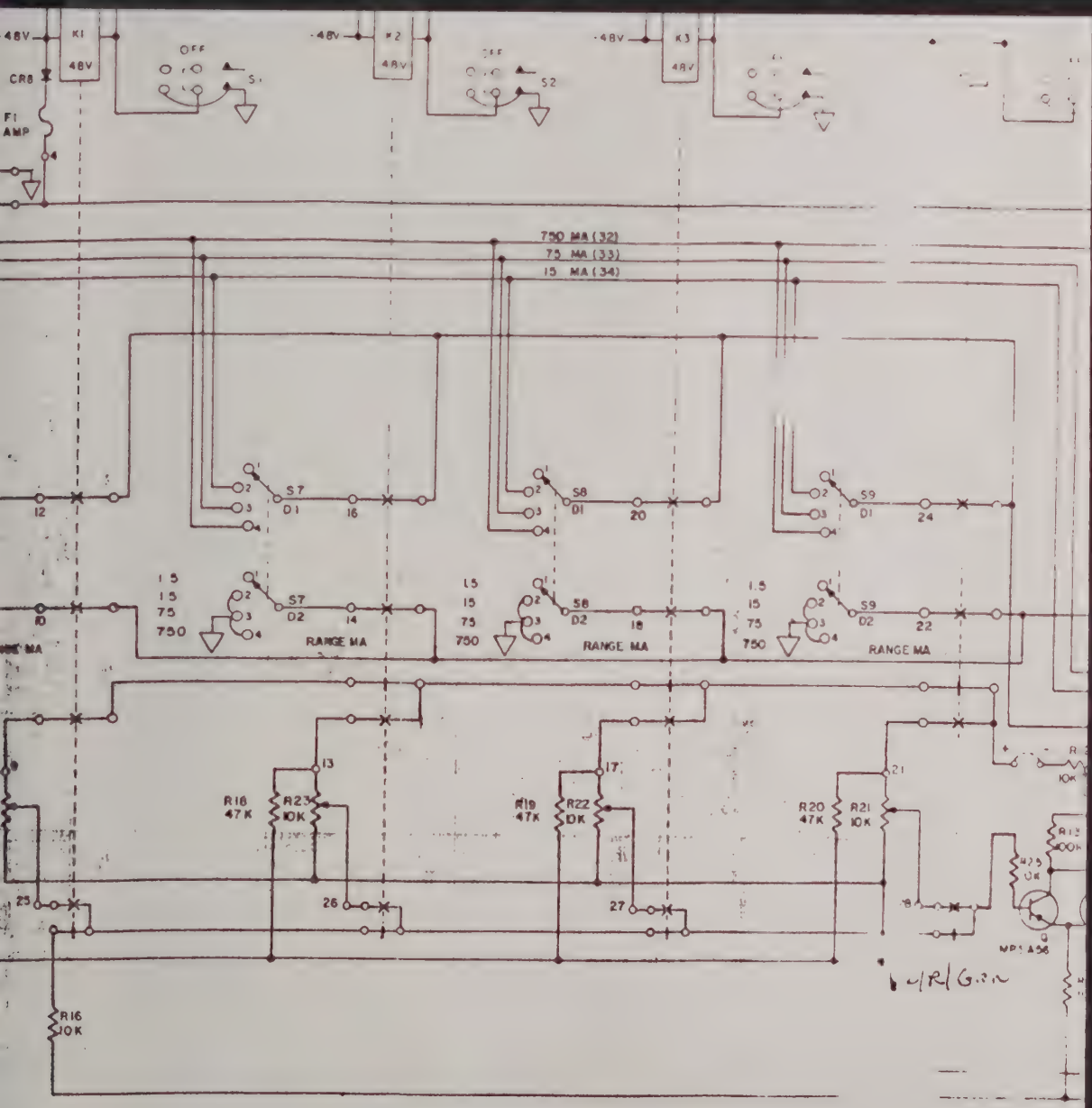


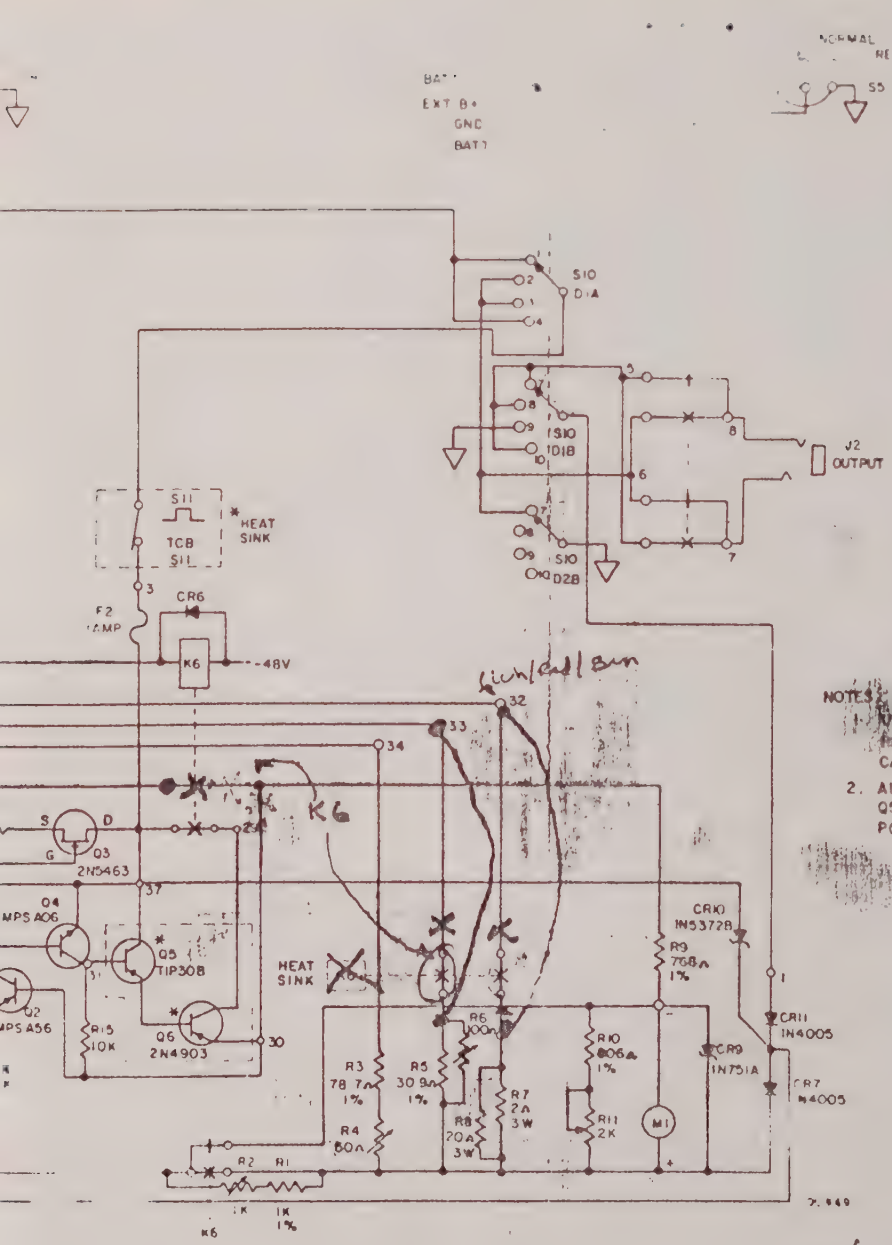


CUT EDGE

Front

9706 96012


-48V
K1
48V
CR8
F1
AMP
OFF
S1
K2
S2
K3
750 MA (32)
75 MA (33)
15 MA (34)
S7
S8
S9
D1
D2
12
16
20
24
22
14
18
1.5
15
75
750
RANGE MA
R16
47K
R23
10K
R19
47K
R22
10K
R20
47K
R21
10K
R16
10K
MPS A56

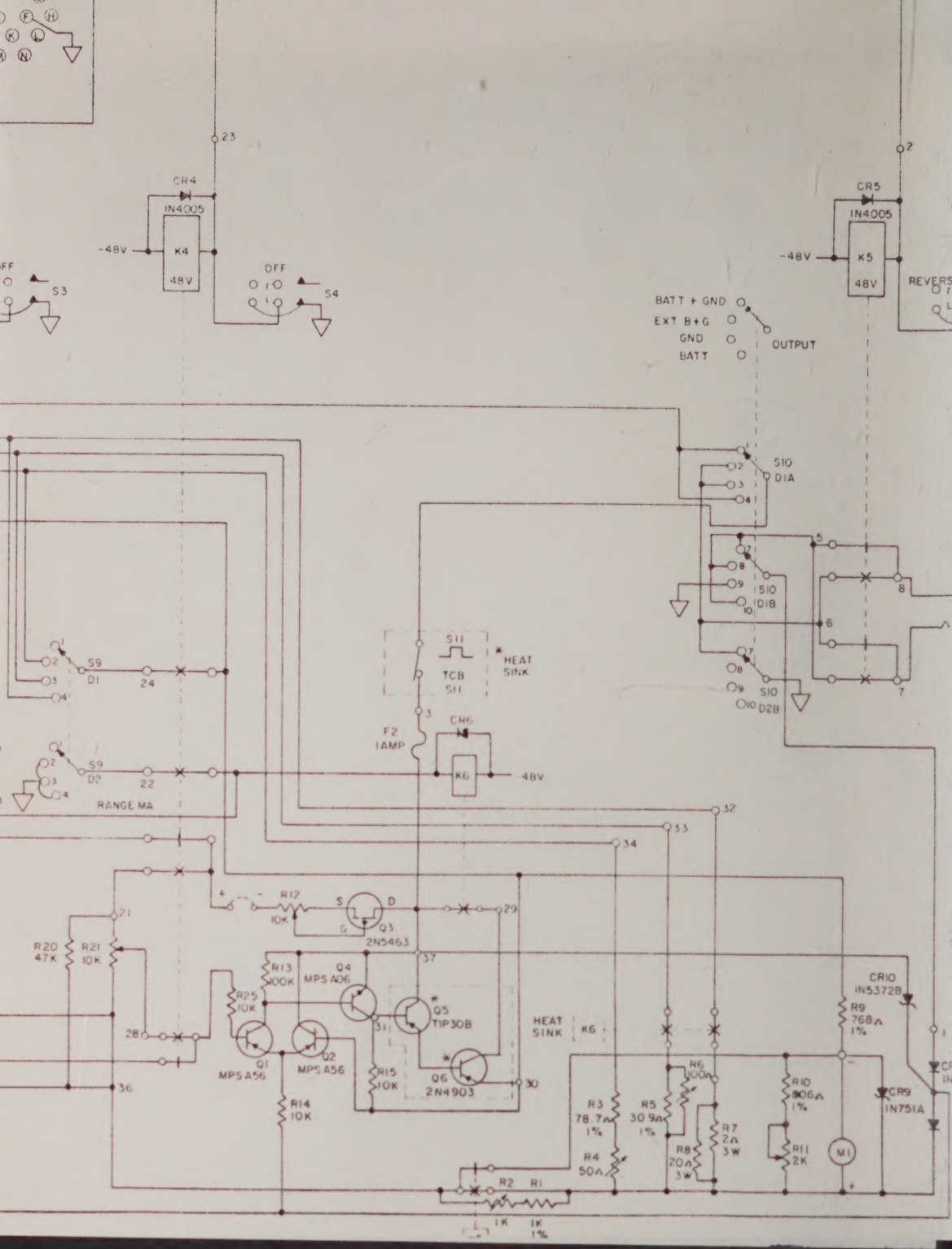


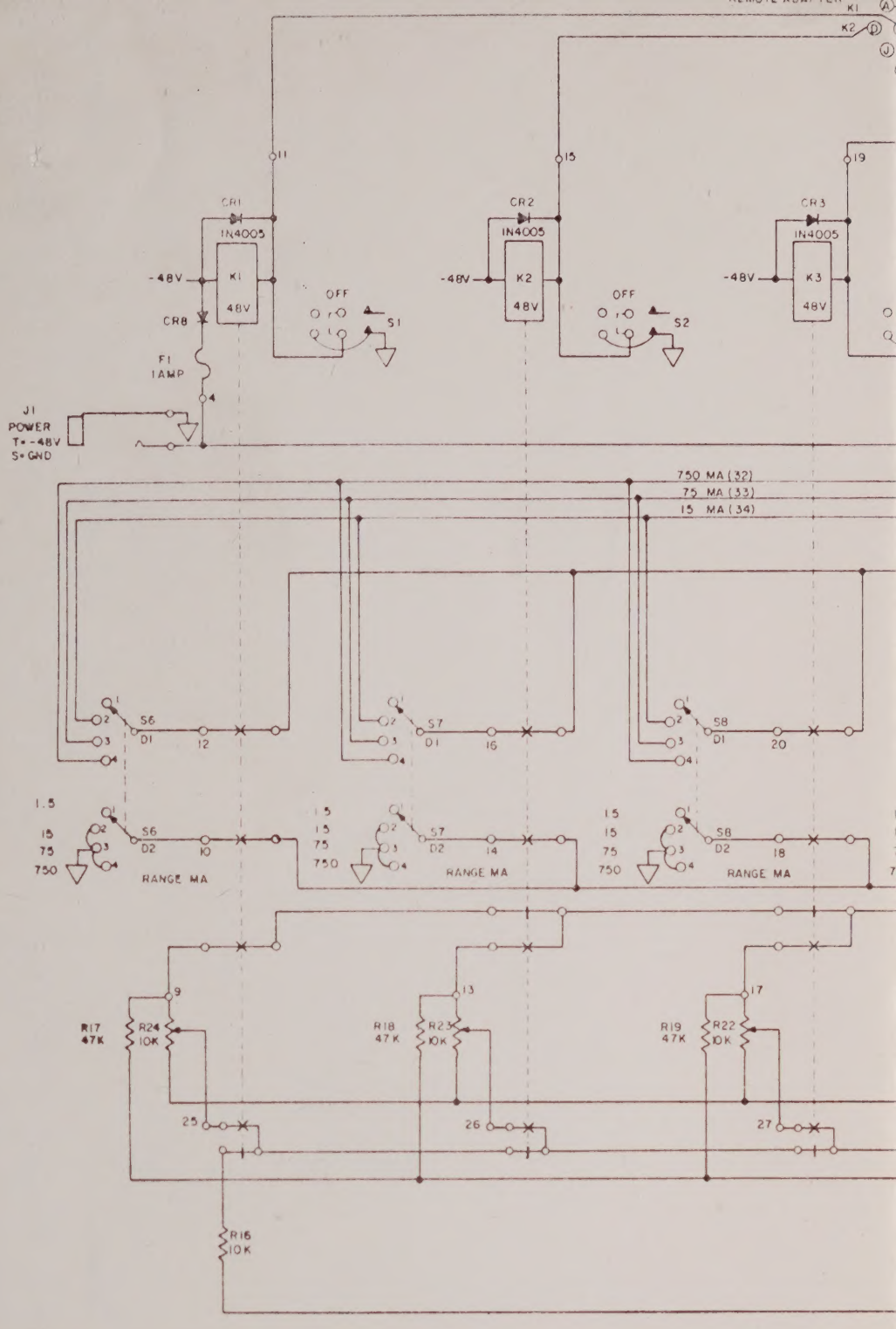
Remove A
Install NO Contact K6
Remove

Per Bob Lamere
01/30/79

Figure 7—1. TTS 77 Overall Schematic Diagram

ECO# 77
D00 77-00-300/ECO 77-00-013


CR4
IN4005
-48V
K4
48V
OFF
S4
23
CR5
IN4005
-48V
K5
48V
2
BATT + GND
EXT B+G
GND
BATT
OUTPUT
S10
D1A
S10
D1B
S10
D2B
S11
TCB
S11
HEAT
SINK
F2
1AMP
CR6
K6
48V
S9
D1
24
S9
D2
22
RANGE MA
32
33
34
R12
10K
Q3
2N5463
29
37
R20
47K
R21
10K
R13
100K
Q4
MPSA06
R25
10K
Q5
TIP30B
HEAT
SINK
K6
CR10
IN5372B
R9
768Ω
1%
28
Q1
MPSA56
Q2
MPSA56
R15
10K
Q6
2N4903
30
36
R14
10K
R3
78.7Ω
1%
R5
30.9Ω
1%
R6
100Ω
R10
806Ω
1%
CR9
IN751A
R4
50Ω
R8
20Ω
3W
R7
2Ω
3W
R11
2K
M1
R2
1K
R1
1K
1%


REMOTE ADAPTER
K1
K2
J
11
15
19
CR1
IN4005
CR2
IN4005
CR3
IN4005
-48V
K1
48V
-48V
K2
48V
-48V
K3
48V
OFF
S1
OFF
S2
CR8
F1
1AMP
4
J1
POWER
T=-48V
S=GND
750 MA (32)
75 MA (33)
15 MA (34)
S6
D1
12
S7
D1
16
S8
D1
20
1.5
15
75
750
S6
D2
10
RANGE MA
1.5
15
75
750
S7
D2
14
RANGE MA
1.5
15
75
750
S8
D2
18
RANGE MA
9
13
17
R17
47K
R24
10K
R18
47K
R23
10K
R19
47K
R22
10K
25
26
27
R16
10K